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Annotated checklist of the coastal ichthyofauna from Michoacán State, Mexico

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Abstract

This study is the first to complete an intensive and comprehensive list of the ichthyofauna of nearly all ecosystems of the Michoacán coast, Mexico. The resulting systematic checklist, supplemented with information from the literature and scientific collections, comprises 440 species belonging to two classes, 31 orders, 104 families, and 264 genera. The families with the highest number of species were Sciaenidae (30 spp.), Carangidae (26), Haemulidae (24), Serranidae (21), Paralichthyidae, and Gobiidae (13). Of the total species list, 134 represent first records for the Michoacán State, and one is a first record for Mexico. The results expand the number of known fish species of the Michoacán coast by almost one third and will help to develop conservation and management plans for this coastal zone.

Keywords

Coastal fish, estuaries, marine, Mexican Central Pacific, systematic list

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Introduction

Mexico has a wealth of both marine species and ecosystems. The country has the world's twelfth longest marine territory, including both Atlantic and Pacific oceans. The geographic and geological history, as well as the ecological and biological richness of areas such as the Gulf of California, the Oceanic islands, and the Caribbean, expands the diversity of Mexican marine life (Lara-Lara et al. 2008), including the ichthyofauna. The few studies pertaining to these taxa have primarily focused on conservation priority zones such as the Gulf of California (e.g. Del Moral-Flores et al. 2013), protected marine areas (e.g. Galván-Villa et al. 2016), or on economically important species (e.g. Lara-Lara et al. 2008).

The Mexican tropical Pacific is part of the biogeographic region known as the Tropical Eastern Pacific (TEP), which comprises three provinces: Cortez or Sinuscalifornia, Mexican, and Panamic (*sensu* Briggs 1974). An estimated 1358 fish species occur in the TEP region, along with an additional of approximately 59 undescribed species (Zapata and Robertson, 2007). The TEP could be considered an area of low richness compared to other biogeographical regions of tropical seas, such as the Indo-Malaysian or the Great Caribbean. However, approximately 71% of identified TEP fish species are considered endemic, making it the tropical region with the highest rate of endemism per unit area in the world (Robertson and Allen 2015). According to Robertson and Allen (2015), the Cortez province possesses 9% of the 515 endemic fish species identified in the coastal ecosystems of the TEP region, whereas the Mexican and the Panamic provinces host 2% and 29% of the endemic component, respectively. Nine percent of the endemic species occur in both the Cortez and Mexican provinces, 10% in both the Mexican and the Panamic provinces, and 37% of the species are found in the three provinces. The endemic fish fauna of the five TEP oceanic islands (Revillagigedo, Galapagos, Cliperton, Coco, and Malpelo) represent, on the other hand, 10% of the total.

The Mexican province is highly productive due to the convergence of the Costa Rica Coastal Current and the California Current, favoring the presence of tropical, temperate, and transitional fish species (Kessler 2006). Based on its lower number of endemic fish species, the Mexican province has been considered a transition zone between the Cortez province in the north and the Panamic to the south (Hastings 2000, Palacios-Salgado 2005, Robertson and Cramer 2009). Attempts to characterize the ichthyofauna of this province are scarce, and most of them refer to a particular group of fishes, region or are based on unpublished reports (Madrid-Vera et al. 1998; Palacios-Salgado 2005, Madrigal-Guridi 2006, Moncayo-Estrada et al. 2006, Chávez-Comparan et al. 2008, López-Pérez et al. 2010, Márquez-Espinoza 2012, Sandoval-Huerta et al. 2012, 2012b, 2014; Palacios-Morales et al. 2014).

The coastline of the Michoacán State, in the Mexican province, is 261.5 km in length and runs from Boca de Apiza, at the mouth of the Coahuayana River, which represents the border with the Colima State to the north, to Barra de San Francisco, at the mouth of the Balsas River, which represents the border with the Guerrero State to the south (Correa and Gómez 2003). There are two contrasting physiographic zones

differing markedly in the marine ecosystems and consequently in the fish species present: (1) the municipalities of Lazaro Cardenas and Coahuayana, which are characterized by coastal plains, with a wide sandy coastline, mangroves, and estuary zones, (2) and the municipality of Aquila comprising numerous cliffs extending into the sea and forming wide zones of rocky reefs, coralline patches, and intertidal pools; estuaries in the last zone are scarce and differ in size and dynamism from those found in Lazaro Cardenas and Coahuyana (Correa and Gómez 2003).

Such heterogeneity in a transitional zone potentially produces high fish species richness. Nevertheless, information on the ichthyofauna of the Michoacán coast is limited, including two study focused on artisanal fishery species (Amezcua-Linares 2009, Sánchez-Aguilar 2007), two on estuarine fishes (Madrigal-Guridi 2006, Sandoval-Huerta et al. 2014) and one including all habitats (Medina-Nava et al. 2001). Madrid-Vera et al. (1998) published the previously most extensive list of the fish fauna of the Michoacán coast, with 257 species, 157 genera, and 76 families recorded in a wide variety of environments. This limited knowledge of the fish fauna contrasts with the importance of the fishery to the economy of the region as the main economic activity, with about 11,931 fishermen producing 6525 tons with an estimated economic value of 145,255,860 MXN (CONAPESCA 2014).

The main goal of this study was to provide an updated checklist of the ichthyofauna from the Michoacán coast including information on fish of local commercial importance and their biogeographic affinity. This knowledge will increase the understanding of regional fish diversity and could be of usefulness for conservation and management strategies of the littoral zone of the Central Mexican Pacific and particularly for the Michoacán State.

Materials and methods

The study area encompassed the coastline of Michoacán state, with 110 locations directly sampled (Fig. 1) and information on 50 additional sites obtained from published literature or scientific collections. These data were obtained through extensive review of the biological material deposited at the Colección de Peces de la Universidad Michoacana de San Nicolás de Hidalgo (**CPUM**), the Colección Nacional de Peces (**UNAM**), the Colección Ictiológica del Instituto de Ciencias del Mar y Limnología (**UNAM**) and the Marine Vertebrate Collection, Scripps Institute of Oceanography (**SIO**). In addition, records from the data base of the fish collection of the California Academy of Sciences (**CAS**) were reviewed. These investigation also included an extensive review of specialized publications (books, catalogues, and field guides) and reports of specimens deposited in ichthyological collections recognized by the Secretaria de Medio Ambiente y Recursos Naturales, México, or specimens of which identification was corroborated by experts.

Field sampling was conducted bimonthly from February 2010 to February 2011, with intermittent sampling in the ensuing year. Sampling was carried out in estuarine

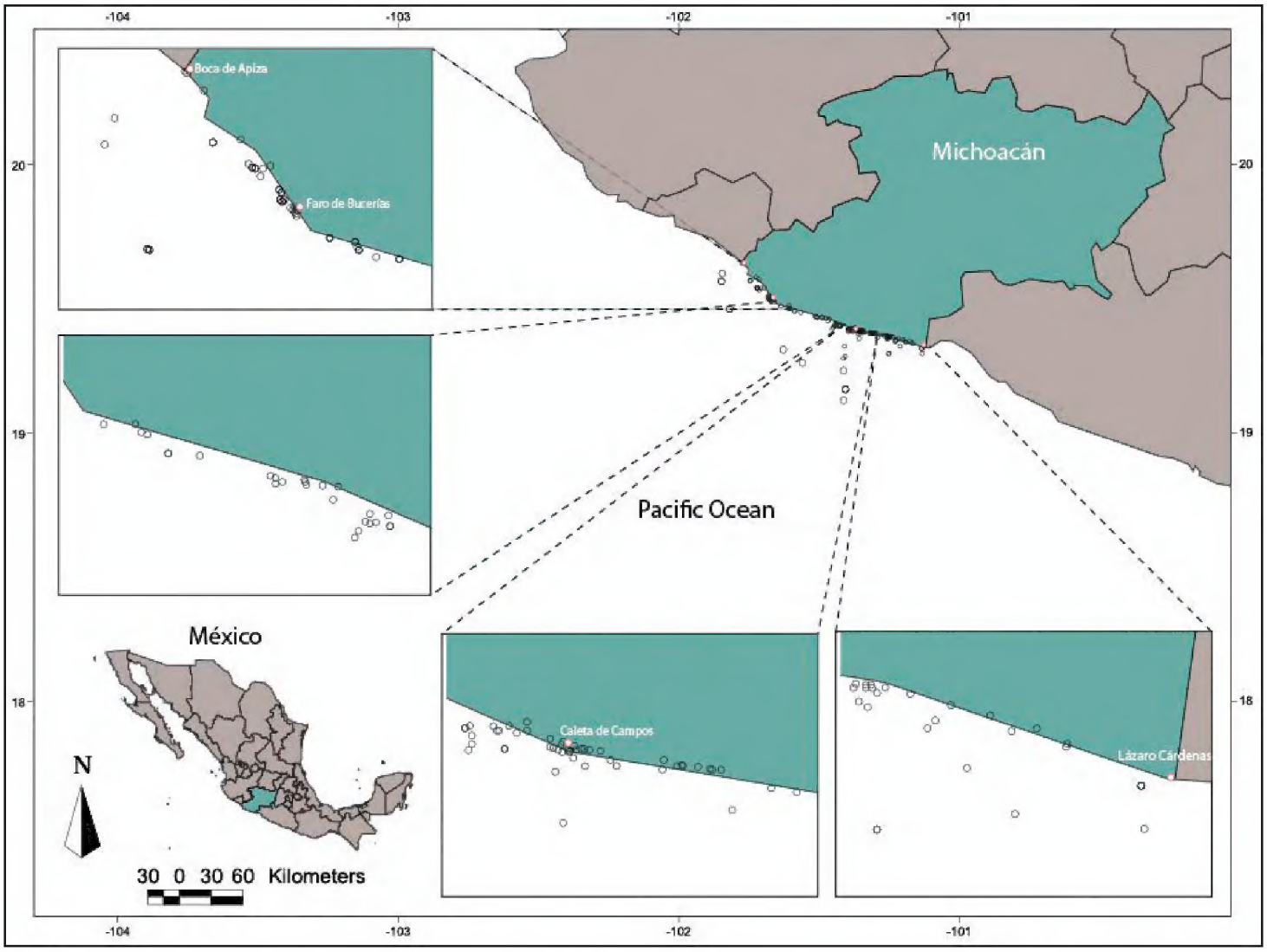

Figure 1. Sampling locations on the coast of Michoacán State.

zones, rocky intertidal pools, rocky reefs, sandy areas, coralline communities, artificial reefs, and the demersal-pelagic area. Methods were tailored to the ecosystem. Reef species were collected via SCUBA diving using elastic band harpoons. Ecologically cryptic (*sensu* Viesca-Lobatón 2005) and intertidal pool species were collected using eugenol (clove oil) anesthetic at a ratio of 1:5 (eugenol:ethanol) for reef and 0.25:9.75 for intertidal pool species. When the organisms were sedated, they were captured with a slurp gun or hand net. For estuarine locations, nocturnal sampling was done using gill nets (12 × 1.8 m and 0.7 to 1.2 cm mesh) and cast nets. For sandy-bottomed sites, a small fishing net (2 × 1.8 m, 1 cm mesh and 3 m bag) was used using a dragging period of 20 min. Captures from a shrimp fishing boat were also analyzed. Aggregations of debris in the open sea were investigated to collect ocean species rarely found in coastal areas. Cooperation with local artisanal fishermen was established to review incidental and commercial catches. Fishermen used lines of 50, 100, and 200 m at 5, 20, and 40 m depth, with hooks of various sizes, fishing with fishhook at a maximum depth of 80 m and gillnets of 7 to 12 cm mesh size. Information about the commercial value and uses of the species also was recorded.

Most specimens were photographed upon collection; tissue samples were taken and deposited at the tissue collection of the CPUM. Specimens were fixed in 5% or 10% formalin neutralized with sodium borate and posteriorly preserved in 70% etha-

nol. Fishes were identified using the keys and descriptions from Springer (1962), Allen and Robertson (1991, 1992, 1998), Fisher et al. (1995), Castro-Aguirre et al. (1999), Hastings and Robertson (1999, 1999b), Thomson et al. (2000), Carpenter and Niem (2001), Miller and Stefanni (2001), Miller et al. (2005), and Robertson and Allen (2015). For some groups, specialized literature was required: Balistidae (Latreille 1804, Shaw 1804-1805, Jordan and Evermann 1900, Froese and Pauly 2003), Rhinobatidae (Himaya and Kumada 1940), Gerreidae (Benitez 2004), Atherinopsidae (Lavenberg and Chernoff 1995), Labrisomidae (Hubbs 1953; Springer1959, Rosenblatt and Parr 1969, Rosenblatt and Taylor 1971), Blenniidae (Springer 1962), Chaenopsidae (Hastings and Robertson 1999), Tripterygiidae (Allen and Robertson 1991, 1992, Rosenblatt et al. 2013), and for the genera *Abudefduf* Forsskål, 1775 (Lessios et al. 1995), *Tomicodon* Brisout de Barneville, 1846, *Gobiesox* Lacepède, 1800 (Briggs 1955; Briggs and Miller 1960), and *Albula* Scopoli, 1777 (Pfeiler 2008). All specimens were deposited at CPUM (MICH-PEC-227-07-09).

The systematic arrangement followed Nelson et al. (2016). The current taxonomic status of each species was corroborated in Eschmeyer et al. (2016). The arrangement of the genera and species was in alphabetical order. In the systematic list, the habitat-type from which each species was collected and the scientific collection by which the specimen was identified, or the scientific document from which information of the specimen was obtained, are indicated.

Finally, a zoogeographical affinity analysis of the species, based on the biogeographical regionalization proposed by Briggs (1974, 1995), was made. Accordingly, the Tropical Eastern Pacific was divided into three provinces. The San Diegan province was also included, since some species tended to have a northern distribution.

Results

Sampling was performed in 13 intertidal pool sites, 20 rocky reef sites, three coralline communities, two artificial reefs, 22 estuarine ecosystems, and 50 soft bottom and open sea sites, collecting 6963 fishes.

The compiled systematic list of ichthyofauna of the Michoacán coast comprises 436 species belonging to two classes, 31 orders, 104 families, and 260 genera (Table 1). The families representing the greatest number of species were Sciaenidae (30), Carangidae (26), Haemulidae (24), Serranidae (21), and Paralichthyidae and Gobiidae (13). The genera with the highest number of species were *Lutjanus* Bloch, 1790 (9), *Carcharhinus* Blainville, 1816 (7), *Anchoa* Jordan and Evermann, 1927 (6), *Diplectrum* Holbrook, 1855 (6), and *Caranx* Lacepède, 1801 (5).

Of the total identified species, 69% were collected and deposited at the CPUM, 22% were obtained from literature records, 7.5% from the review of museum specimens, and 1% from databases of ichthyological collections (Table 1). In addition, seven species were recorded through video and photographic evidence: *Ginglymostoma unami* Del Moral Flores, Ramírez-Antonio, Angulo y Pérez-Ponce de León, 2015,

Table 1. Updated checklist of the coastal ichthyofauna from Michoacán, Mexico.

	Collected habitat (2010–2011)	Ichthyogeographic affinity	References and organisms voucher	The importance in fisheries
CLASS ELASMOBRANCHII				
ORDER ORECTOLOBIFORMES				
FAMILY GINGLYMOSTOMATIDAE				
Ginglymostoma unami Del Moral Flores, Ramírez-Antonio, Angulo y Pérez-Ponce de León, 2015	R	AA	2, 4, 6, CPUM	A
ORDER LAMNIFORMES				
FAMILY LAMINIDAE				
Isurus oxyrinchus Rafinesque, 1810		CT	1	
FAMILY ALOPIIDAE				
Alopias pelagicus Nakamura, 1935		AP	2	
Alopias superciliosus (Lowe, 1841)		CT	2	
ORDER CARCHARHINIFORMES				
FAMILY TRIAKIDAE				
Mustelus lunulatus Jordan & Gilbert, 1882	D	TEP	2, 6	
FAMILY CARCHARHINIDAE				
Carcharhinus albimarginatus (Rüppell, 1837)		CT	2	
Carcharhinus brachyurus (Günther, 1870)		CT	2	
Carcharhinus cerdale Gilbert, 1898		TEP	1, 2	
Carcharhinus falciformis (Müller & Henle, 1839)		CT	2	
Carcharhinus leucas (Müller & Henle, 1839)		CT	1, 2	
Carcharhinus limbatus (Müller & Henle, 1839)	D	CT	1, 2, 6, CPUM	C
Carcharhinus obscurus (Lesueur, 1818)		CT	1, 2	
Galeocerdo cuvier (Péron & Lesueur, 1822)		CT	1, 2	
Nasolamia velox (Gilbert, 1898)		TEP	2	
Negaprion brevirostris (Poey, 1868)		AA	1, 2	
Rhizoprionodon longurio (Jordan & Gilbert, 1882)	D	SP, TEP	1, 2, CPUM	C
FAMILY SPHYRNIDAE				
Sphyrna lewini (Griffith & Smith, 1834)	D	CT	1, 2, 4, 6, 9, CPUM	C
Sphyrna zygaena (Linnaeus, 1758)		CT	2	
ORDER TORPEDINIFORMES				
FAMILY NARCINIDAE				
Narcine entemedor Jordan & Starks, 1895	D	TEP	1, 9, CPUM	I
**Narcine vermiculatus* Breder, 1928	D	MP, PP	6, 9, CPUM, ICMYL, CIBNOR	I
ORDER PRISTIFORMES				
FAMILY PRISTIDAE				
**Pristis pristis* (Linnaeus, 1758)	PD	AA	CPUM-photo	C
ORDER RAJIFORMES				
FAMILY RHINOBATIDAE				
Rhinobatos glaucostigma Jordan & Gilbert, 1883	R	TEP	1, 2, 4, 6, 9, CPUM, ICMYL	C
Rhinobatos productus Ayres, 1856		SP, TEP	2	
**Zapteryx xyster* Jordan & Evermann,1896	R	TEP	CPUM, SIO	I

	Collected habitat (2010–2011)	Ichthyogeographic affinity	References and organisms voucher	The importance in fisheries
FAMILY RAJIDAE				
Raja equatorialis Jordan & Bollman, 1890		MP, PP	1	
ORDER MYLIOBATIFORMES				
FAMILY UROTRYGONIDAE				
Urotrygon aff. *aspidura* (Jordan & Gilbert, 1882)		TEP	1	
Urotrygon chilensis (Günther, 1872)		TEP	1, 2, 9	
Urotrygon munda Gill, 1863		TEP	2	
Urotrygon nana Miyake & McEachran, 1988		TEP	1, 9	
Urotrygon rogersi (Jordan & Starks, 1895)	PD	TEP	1, 4, 9, CPUM, SIO	I
FAMILY GYMNURIDAE				
Gymnura marmorata (Cooper, 1863)		SP, TEP	1, 9, CPUM	C
FAMILY MYLIOBATIDAE				
Aetobatus laticeps (Euphrasen, 1790)	R	CT	2, 4, CPUM-photo	I
FAMILY MYLIOBATIDAE				
**Rhinoptera steindachneri* Evermann & Jenkins, 1891	PD	TEP	CPUM	I
FAMILY MOBULIDAE				
**Mobula munkiana* Notarbartolo di Sciara, 1987	PD	TEP	CPUM	C
FAMILY UROTRYGONIDAE				
Urobatis concentricus Osburn & Nichols, 1916	R	TEP	1, 6, CPUM	
Urobatis halleri (Cooper, 1863)	R	TEP	2, CPUM	
FAMILY DASYATIDAE				
Dasyatis dipterura (Jordan & Gilbert, 1880)	D	TEP	2, 9, CIBNOR	
Dasyatis longus (Garman, 1880)	PD	SP, TEP	1, CPUM	I
CLASS ACTINOPTERYGII				
ORDER ELOPIFORMES				
FAMILY ELOPIDAE				
Elops affinis Regan, 1909	E	SP, TEP	2, CPUM	C
ORDER ALBULIFORMES				
FAMILY ALBULIDAE				
Albula pacifica (Beebe, 1942)	D	MP, PP	1, 2, 9, CPUM	C
ORDER ANGUILLIFORMES				
FAMILY MURAENIDAE				
**Echidna nocturna* (Cope, 1872)	PM, R	CP, MP	CPUM	
**Enchelycore octaviana* (Myers & Wade, 1941)	PM, R	CP, MP	CPUM	
Gymnomuraena zebra (Shaw, 1797)	R	AP	2, 6, CPUM	I
Gymnothorax castaneus (Jordan & Gilbert, 1883)	PM, R	TEP	2, 6, CPUM	
**Gymnothorax equatorialis* (Hildebrand, 1946)	R	TEP	9, CPUM	
**Muraena argus* (Steindachner, 1870)		TEP	ICMYL	
Muraena lentiginosa Jenyns, 1842	PM, R	TEP	2, 4, 5, 9, CPUM	
**Uropterygius macrocephalus* (Bleeker, 1864)	PM	TEP	CPUM	
FAMILY OPHICHTHIDAE				
**Apterichtus equatorialis* (Myers & Wade, 1941)	R	TEP	CPUM	
**Echiophis brunneus* (Castro-Aguirre & Suárez de los Cobos, 1983)	R	TEP	9, CPUM	
**Myrichthys aspetocheiros* McCosker & Rosenblatt, 1993	R	CP, MP	6, CPUM	

	Collected habitat (2010–2011)	Ichthyogeographic affinity	References and organisms voucher	The importance in fisheries
Ophichthus triserialis (Kaup, 1856)	R	TEP	2, CPUM, ICMYL	I
Ophichthus zophochir Jordan & Gilbert, 1882	R	TEP	1, 2, CPUM, ICMYL	I
FAMILY CONGRIDAE				
**Ariosoma gilberti* (Ogilby, 1898)	D	MP, PP	9	
Heteroconger digueti (Pellegrin, 1923)		TEP	2	
**Paraconger californiensis* Kanazawa, 1961		TEP	SIO	
**Rhynchoconger nitens* (Jordan & Bollman, 1890)	D	TEP	9, CPUM, ICMYL	I
ORDER CLUPEIFORMES				
FAMILY CLUPEIDAE				
Harengula thrissina (Jordan & Gilbert, 1882)	PM	SP, TEP	2, 4, 6, 9, CPUM	A
Lile gracilis Castro-Aguirre & Vivero, 1990	E	MP, PP	1, 12, CPUM	
Lile nigrofasciata Castro-Aguirre, Ruiz-Campos & Balart, 2002	E	TEP	1, 10, 12, 13, CPUM	
Lile stolifera (Jordan & Gilbert, 1882)	E	TEP	CPUM	
**Opisthonema bulleri* (Regan, 1904)	PD	TEP	CPUM	A
Opisthonema libertate (Günther, 1867)	E	SP, TEP	2, 8, CPUM	A
**Opisthonema medirastre* Berry & Barrett, 1963	PM	TEP	CPUM	A
FAMILY ENGRAULIDAE				
**Anchoa argentivittata* (Regan, 1904)	PM	TEP	CPUM	A
Anchoa ischana (Jordan & Gilbert, 1882)		TEP	2, 5	
Anchoa lucida (Jordan & Gilbert, 1882)	E	TEP	2, 12, CPUM	
Anchoa mundeola (Gilbert & Pierson, 1898)		TEP	2	
**Anchoa nasus* (Kner & Steindachner, 1867)	PM	TEP	CPUM, ICMYL	
Anchoa scofieldi (Jordan & Culver, 1895)	PD	MP, PP	2, 4, CPUM	A
**Anchovia macrolepidota* (Kner, 1863)	PD	SP, TEP	CPUM	A
Cetengraulis mysticetus (Günther, 1867)	PD	TEP	2, CPUM	A
FAMILY PRISTIGASTERIDAE				
Ilisha fuerthii (Steindachner, 1875)		MP, PP	2, 7	
**Opisthopterus dovii* (Günther, 1868)		TEP	8	
Pliosteostoma lutipinnis (Jordan & Gilbert, 1882)	E	TEP	1, 8, 9, 10, 12, 13, CPUM	A
ORDER GONORYNCHIFORMES				
FAMILY CHANIDAE				
Chanos chanos (Forsskål, 1775)	PD	CT	2, 7, CPUM	C
ORDER CYPRINIFORMES				
FAMILY CYPRINIDAE				
Cyprinus carpio Linnaeus, 1758	E	Introduced	CPUM	
ORDER SILURIFORMES				
FAMILY ARIIDAE				
Bagre panamensis (Gill, 1863)		TEP	2	
Bagre pinnimaculatus (Steindachner, 1876)		TEP	2	
Cathorops dasycephalus (Günther, 1864)		MP, PP	2	
Notarius kessleri (Steindachner, 1877)		MP, PP	1, 2	
Notarius planiceps (Parr, 1931)		MP, PP	1, 2	
Occidentarius platypogon (Steindachner, 1877)	E, D	SP, TEP	1, 8, 9, CPUM	C
Sciades guatemalensis (Günther, 1864)	E	MP, PP	1, 2, CPUM	C
Sciades seemanni (Günther, 1864)		TEP	1, CNPE-IBUNAM	

	Collected habitat (2010–2011)	Ichthyogeographic affinity	References and organisms voucher	The importance in fisheries
FAMILY LORICARIIDAE				
Pterygoplichthys disjunctivus (Weber, 1991)	E	Introduced	10, CPUM	
ORDER OSMERIFORMES				
FAMILY BATHYLAGIDAE				
**Bathylagoides nigrigenys* Garman, 1899		MP, PP	SIO	
ORDER STOMIIFORMES				
FAMILY GONOSTOMATIDAE				
**Cyclothone acclinidens* (Garman, 1899)		CT	SIO	
FAMILY PHOSICHTHYIDAE				
**Vinciguerria lucetia* (Garman, 1899)		AP	SIO	
FAMILY STOMIIDAE				
**Bathophilus filifer* Gilbert, 1890		AP	SIO	
**Idiacanthus antrostomus* (Parr, 1929)		AP	SIO	
ORDER AULOPIFORMES				
FAMILY SCOPELARCHIDAE				
**Scopelarchoides nicholsi* Jordan & Bollman, 1890		SP, TEP	SIO	
FAMILY SYNODONTIDAE				
**Synodus evermanni* Gilbert, 1890	R	TEP	9, CPUM, SIO	I
**Synodus lacertinus* Jordan & Gilbert, 1882	R	TEP	9, CPUM	
Synodus scituliceps Hildebrand, 1946		TEP	1, 2, 9, ICMYL	
**Synodus sechurae* Parr, 1931	PD	TEP	CPUM	I
ORDER MYCTOPHIFORMES				
FAMILY MYCTOPHIDAE				
**Diaphus pacificus* Hubbs, 1944		AP	CAS	
**Diogenichthys laternatus* (Jordan & Bollman, 1890)		AP	CAS	
**Lampanyctus omostigma* (Gilbert, 1890)		AP	CAS	
**Lampanyctus parvicauda* Parr, 1931		AP	SIO	
**Myctophum aurolaternatum* (Putnam, 1874)		AP	ANSP	
ORDER OPHIDIIFORMES				
FAMILY OPHIDIIDAE				
Brotula clarkae Hubbs, 1944		TEP	1	
**Lepophidium prorates* (Jordan & Bollman, 1890)	D	TEP	9, SIO, ICMYL	
**Otophidium indefatigabile* (Richardson, 1844)	D	TEP	9, ICMYL, CIBNOR	
FAMILY CARAPIDAE				
Carapus dubius (Putnam, 1874)		AP	1	
ORDER BATRACHOIDIFORMES				
FAMILY BATRACHOIDIDAE				
**Batrachoides waltersi* Collette & Russo, 1981		MP, PP	ICMYL	
**Porichthys ephippiatus* Walker y Rosenblatt, 1988		TEP	CPUM, SIO	I
**Porichthys margaritatus* (Richardson, 1844)		TEP	9, CIBNOR	
ORDER LOPHIIFORMES				
FAMILY LOPHIIDAE				
Lophiodes caulinaris (Garman, 1899)		SP, TEP	1, 9, SIO, ICMYL	
Lophiodes spilurus (Garman, 1899)		TEP	1	

	Collected habitat (2010–2011)	Ichthyogeographic affinity	References and organisms voucher	The importance in fisheries
FAMILY ANTENNARIIDAE				
**Antennatus sanguineus* (Gill, 1863)		SP, TEP	6	
**Antennatus strigatus* (Gill, 1863)	R	TEP	6, CPUM, ICMYL	
**Fowlerichthys avalonis* (Bancroft, 1834)	R	SP, TEP	6, 9, CPUM	
FAMILY OGCOCEPHALIDAE				
Zalieutes elater (Jordan y Gilbert, 1882)	PD	SP, TEP	1, 2, 9, CPUM, SIO, ICMYL	I
ORDER GOBIESOCIFORMES				
FAMILY GOBIESOCIDAE				
**Arcos erythrops* (Jordan & Gilbert, 1882)	PM, R	CP, MP	CPUM	
**Gobiesox adustus* Jordan & Gilbert, 1882	PM, R	TEP	CPUM	
Gobiesox mexicanus Briggs & Miller, 1960	E	Freshwater	CPUM	
**Tomicodon petersii* (Garman, 1875)	R	MP, PP	CPUM	
Tomicodon zebra (Jordan & Gilbert, 1882)	PM	CP, MP	2, CPUM	
ORDER ATHERINIFORMES				
FAMILY ATHERINOPSIDAE				
**Atherinella eriarcha* Jordan y Gilbert, 1882	PM	TEP	4, CPUM, CNPE-IBUNAM	
Atherinella guatemalensis (Günther, 1864)	E	MP, PP	1, 8, 12, CPUM, CNPE-IBUNAM	
Atherinella panamensis Steindachner, 1875	E	MP, PP	8, 10, 12, CPUM	
ORDEN CYPRINODONTIFORMES				
FAMILIA POECILIDAE				
Poecilia butleri Jordan, 1889	E	Freshwater	8, 10, 12, 13, CPUM	
ORDER BELONIFORMES				
FAMILY BELONIDAE				
Platybelone argalus (Lesueur, 1821)		CT	2, SIO, ANSP	
Strongylura exilis (Girard, 1854)		SP, TEP	2, 6	
Tylosurus fodiator Jordan y Gilbert, 1882	PD	TEP	2, CPUM	C
FAMILY HEMIRAMPHIDAE				
Hemiramphus saltator Gilbert & Starks, 1904	PD	TEP	1, 6, CPUM	
Hyporhamphus naos Banford & Collette, 2001	PD	TEP	1, CPUM	A
**Oxyporhamphus micropterus* (Valenciennes, 1847)		CT	SIO	
FAMILY EXOCOETIDAE				
**Cheilopogon furcatus* (Mitchill, 1815)		CT	SIO	
**Cheilopogon papilio* (Clark, 1936)		SP, CP, MP	SIO	
Cypselurus callopterus (Günther, 1866)		SP, CP, MP	1, 2, SIO	
**Exocoetus monocirrhus* Richardson, 1846		AP	SIO	
Fodiator rostratus (Günther, 1866)		TEP	2, SIO	
**Prognichthys tringa* Breder, 1928		AP	SIO	
ORDER STEPHANOBERYCIFORMES				
FAMILY MELAMPHAIDAE				
**Scopelogadus mizolepis* (Günther, 1878)		CT	CAS	
ORDER BERYCIFORMES				
FAMILY HOLOCENTRIDAE				
Sargocentron suborbitale (Gill,1863)	PM, R	TEP	2, 4, 5, 6, CPUM, SIO, ICMYL	

	Collected habitat (2010–2011)	Ichthyogeographic affinity	References and organisms voucher	The importance in fisheries
Myripristis leiognathus Valenciennes, 1846	R	SP, TEP	2, 5, 6, 9, CPUM	
ORDER SYNGNATHIFORMES				
FAMILY FISTULARIIDAE				
Fistularia commersonii Rüppell, 1838	R	AP	1, 2, 6, CPUM	
**Fistularia corneta* Gilbert & Starks, 1904	R	SP, TEP	CPUM	
FAMILY SYNGNATHIDAE				
**Doryrhamphus excisus* Kaup, 1856	R	AP	CPUM	
Hippocampus ingens Girard, 1858	R	SP, TEP	1, 2, 6, 9, CPUM, ICMYL	
Pseudophallus starksii (Jordan & Culver, 1895)	E	TEP	1, 12, CPUM, CNPE-IBUNAM	
ORDER SCORPAENIFORMES				
FAMILY SCORPAENIDAE				
Scorpaena histrio Jenyns, 1840		TEP	2	
*Scorpaena mystes (*Jordan & Starks, 1895)	R	AA	1, 6, 9, CPUM, ICMYL	I
Scorpaena russula Jordan & Bollman, 1890		TEP	1, 9	
**Scorpaena sonorae* Jenkins & Evermann, 1889	PD	CP, PP	CPUM	I
**Scorpaenodes xyris* (Jordan & Gilbert, 1882)	R	SP, TEP	CPUM	
FAMILY TRIGLIDAE				
**Bellator gymnostethus* (Gilbert, 1892)		TEP	9	
Bellator loxias (Jordan, 1897)		TEP	2	
Bellator xenisma (Jordan & Bollman, 1890)		TEP	1, 2, 9	
Prionotus albirostris Jordan & Bollman, 1890		TEP	1, 9	
Prionotus horrens Richardson, 1844		TEP	1	
Prionotus ruscarius Gilbert & Starks, 1904	R	SP, TEP	1, 2, 9, CPUM, SIO	A
Prionotus stephanophrys Lockington, 1881	R	SP, TEP	1, 2, 9, CPUM, ICMYL	A
ORDER PERCIFORMES				
FAMILY CENTROPOMIDAE				
Centropomus armatus Gill, 1863	PD	MP, PP	2, 7, 8, CPUM	C
Centropomus medius Günther, 1864	PD	SP, TEP	1, 2, CPUM	C
Centropomus nigrescens Günther, 1864	E	TEP	2, 4, 10, 12, 13, CPUM	C
Centropomus robalito Jordan & Gilbert, 1882	E	TEP	2, 3, CPUM	
Centropomus viridis Lockington, 1877	E	TEP	1, 2, 3, 7, 8, CPUM	
FAMILY SERRANIDAE				
Alphestes inmaculatus Breder, 1936	R	TEP	2, 6, CPUM	I
Alphestes multiguttatus (Günther, 1867)	R	TEP	2, 4, 5, 6, CPUM	I
Cephalopholis panamensis (Steindachner, 1877)	R	TEP	2, 4, 6, CPUM	
Dermatolepis dermatolepis (Boulenger, 1895)	R	TEP	2, 6, CPUM-photo	
Diplectrum eumelum Rosenblatt & Johnson, 1974	R	TEP	1, 9, CPUM, SIO	
**Diplectrum euryplectrum* Jordan & Bollman, 1890	R	TEP	CPUM, ICMYL	
Diplectrum labarum Rosenblatt & Johnson, 1974	R	TEP	1, 9, CPUM, SIO	

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Diplectrum macropoma (Günther, 1864)	R	TEP	1, CPUM, SIO	
Diplectrum pacificum Meek & Hildebrand, 1925	R	TEP	2, 4, 6, 9, CPUM	
**Diplectrum rostrum* Bortone, 1974	PD	TEP	CPUM	A
Epinephelus analogus Gill, 1863	R	SP, TEP	1, 2, 4, 6, 9, CPUM, ICMYL, CNPE-IBUNAM	C
Epinephelus labriformis (Jenyns, 1840)	PM, R	TEP	1, 2, 4, 6, 9, CPUM	C
Hyporthodus acanthistius (Gilbert, 1892)	R	TEP	1, 2, 4, 9, CPUM, ICMYL	C
**Hyporthodus exsul* (Fowler, 1944)		TEP	SIO	
Hyporthodus niphobles Gilbert & Starks, 1897	R	SP, TEP	1, CPUM	C
**Paralabrax loro* Walford, 1936	R	TEP	9, CPUM	C
Paranthias colonus (Valenciennes, 1846)	R	TEP	2, 6, CPUM, ICMYL	C
**Pseudogramma thaumasia* (Gilbert, 1900)	R	TEP	CPUM	
Rypticus bicolor Valenciennes, 1846	PM, R	TEP	1, CPUM	A
**Rypticus nigripinnis* Gill, 1861		TEP	9, ICMYL	
Serranus psittacinus Valenciennes, 1846		TEP	2	
FAMILY PRIACANTHIDAE				
Heteropriacanthus cruentatus (Lacepède, 1801)		CT	2, 6	
Pristigenys serrula (Gilbert, 1891)	D	TEP	1, 2, 6, 9, CPUM	
FAMILY APOGONIDAE				
Apogon pacificus (Herre, 1935)	R	TEP	1, 6, CPUM-photo, ICMYL	
Apogon retrosella (Gill, 1862)	PM, R	TEP	2, 6, CPUM	
FAMILY ECHENEIDAE				
**Phtheirichthys lineatus* (Menzies, 1791)		CT	ANSP	
**Remora osteochir* (Cuvier, 1829)		CT	SIO	
Remora remora (Linnaeus, 1758)	D	CT	2, CPUM, CNPE-IBUNAM	
FAMILY CARANGIDAE				
Alectis ciliaris (Bloch, 1787)	PD	CT	1, 2, 9, CPUM	C
Carangoides otrynter (Jordan & Gilbert, 1883)	R	SP, TEP	1, 2, 4, CPUM, ICMYL	C
Carangoides vinctus Jordan & Gilbert, 1882	D	SP, TEP	1, 2, 9, CPUM, ICMYL, CNPE-IBUNAM	C
Caranx caballus Günther, 1868	PM, R	SP, TEP	1, 2, 4, 6, CPUM, ICMYL	C
Caranx caninus Günther, 1867	R, E	SP, TEP	1, 2, 9, 12, CPUM, SIO, CIBNOR	C
Caranx lugubris Poey, 1860	PD	TEP	2, CPUM	C
Caranx melampygus Cuvier, 1833		CT	2, 6	
Caranx sexfasciatus Quoy & Gaimard, 1825	R, E	AP	2, 7, 8, CPUM	C
Chloroscombrus orqueta Jordan & Gilbert, 1883	PM	SP, TEP	1, 2, 9, CPUM, CNPE-IBUNAM	A
**Decapterus macrosoma* Bleeker, 1851	PD	AP	CPUM	C
Decapterus muroadsi (Temminck & Schlegel, 1844)		CT	1, 2	

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Elagatis bipinnulata (Quoy & Gaimard, 1825)	PD	CT	1, 2, CPUM	C
Gnathanodon speciosus (Forsskål, 1775)		AP	2	
Hemicaranx leucurus (Günther, 1864)		TEP	2	
Hemicaranx zelotes Gilbert, 1898		TEP	2, 7	
Oligoplites altus (Günther, 1868)	PD	TEP	2, CPUM	C
Oligoplites refulgens Gilbert & Starks, 1904	PD	TEP	2, CPUM	C
Oligoplites saurus (Bloch & Schneider, 1801)	E	TEP	2, CPUM	
Selar crumenophthalmus (Bloch, 1793)	R, E	CT	1, 2, 8, CPUM, SIO	C
Selene brevoortii (Gill, 1863)	R, E	SP, TEP	1, 2, CPUM	A
Selene peruviana (Guichenot, 1866)	R	TEP	1, 2, 9, CPUM	A
Seriola peruana Steindachner, 1881	R	TEP	2, CPUM	C
Seriola rivoliana Valenciennes, 1833	PD	CT	2, CPUM	C
**Trachinotus kennedyi* Steindachner, 1876	E	TEP	2, CPUM, CNPE-IBUNAM	
Trachinotus paitensis Cuvier, 1832		TEP	1, 2	
Trachinotus rhodopus Gill, 1863	PM, R, E	SP, MP, PP	1, 2, 4, 6, 7, 12, CPUM, ICMYL	
FAMILY NEMATISTIIDAE				
Nematistius pectoralis Gill, 1862	PD	TEP	2, 4, CPUM	C
FAMILY CORYPHAENIDAE				
**Coryphaena equiselis* Linnaeus, 1758		CT	SIO	
Coryphaena hippurus Linnaeus, 1758	PD	CT	2, 4, CPUM-photo	C
FAMILY LUTJANIDAE				
Hoplopagrus guentherii Gill, 1862	R	SP, TEP	1, 2, 6, CPUM	C
Lutjanus aratus (Günther, 1864)		TEP	1	
Lutjanus argentiventris (Peters, 1869)	PM, R, E	SP, TEP	1, 2, 6, 12, CPUM, CNPE-IBUNAM	C
Lutjanus colorado Jordan & Gilbert, 1882	R, E	SP, TEP	1, 2,4, 6, 8, CPUM	C
Lutjanus guttatus (Steindachner, 1869)	R	TEP	1, 2, 4, 6, CPUM, SIO, ICMYL	C
Lutjanus inermis (Peters, 1869)	R	TEP	1, 2, CPUM, ICMYL	C
**Lutjanus jordani* (Gilbert, 1898)		TEP	6	
Lutjanus novemfasciatus Gill, 1862	PM, R, E	SP, TEP	1, 2, 4, 6, 7, 8, 10, 12, 13, CPUM	C
Lutjanus peru (Nichols & Murphy, 1922)	R	SP, TEP	1, 2, 4, 9, CPUM, ICMYL	C
**Lutjanus viridis* (Valenciennes, 1846)	PD	TEP	6, CPUM	
FAMILY LOBOTIDAE				
Lobotes pacificus Gilbert, 1898	PD	CT	1, CPUM	C
FAMILY GERREIDAE				
Deckerichthys aureolus (Jordan & Gilbert, 1882)	D	TEP	1, 2, 9, CPUM, ICMYL	C
Diapterus brevirostris (Sauvage, 1879)	E	TEP	1, 2, CPUM	C
Eucinostomus currani Zahuranec, 1980	PM, E	SP, TEP	1, 2, 7, 8, 9, 10, 12, 13, CPUM, CNPE-IBUNAM	C
Eucinostomus dowii (Gill, 1863)		SP, TEP	1	

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**Eucinostomus entomelas* Zahuranec, 1980		SP, TEP	CNPE-IBUNAM	
Eucinostomus gracilis (Gill, 1862)		TEP	1, 2, 9	
**Eugerres axillaris* (Günther, 1864)	R, E	TEP	CPUM	
Eugerres brevimanus (Günther, 1864)		MP, PP	1	
**Eugerres lineatus* (Humboldt, 1821)	E	TEP	CPUM	
Gerres simillimus Reagan, 1907	R, E	TEP	1, 2, 4, 7, CPUM	C
FAMILY HAEMULIDAE				
**Anisotremus caesius* (Jordan & Gilbert, 1882)	R	MP, PP	CPUM, CNPE-IBUNAM	C
Anisotremus interruptus (Gill, 1862)	R	SP, TEP	1, 2, 4, 6, CPUM, ICMYL, CNPE-IBUNAM	C
Anisotremus taeniatus Gill, 1861	R	SP, TEP	2, 6, CPUM	C
Conodon serrifer Jordan & Gilbert, 1882		SP, TEP	1, ICMYL	
Genyatremus dovii (Günther, 1864)	R	TEP	2, CPUM, ICMYL, CNPE-IBUNAM	C
Genyatremus pacifici (Günther, 1864)		MP, PP	2	
Haemulon californiensis (Steindachner, 1876)		TEP	2	
Haemulon flaviguttatum Gill, 1862	R	SP, TEP	1, 2, 4, 6, CPUM, ICMYL	C
Haemulon maculicauda (Gill, 1862)	R	SP, TEP	2, 6, CPUM, ICMYL	C
Haemulon scudderii Gill, 1862	R	SP, TEP	1, 2, CPUM	C
Haemulon sexfasciatum Gill, 1862	R	TEP	1, 2, 6, CPUM	C
Haemulon steindachneri (Jordan & Gilbert, 1882)	R	AA	2, CPUM, ICMYL, CNPE-IBUNAM	C
Haemulopsis axillaris (Steindachner, 1869)	R	MP, PP	2, CPUM	C
Haemulopsis elongatus (Steindachner, 1879)	R	MP, PP	1, CPUM, ICMYL	C
Haemulopsis leuciscus (Günther, 1864)	E	TEP	1, 2, 6, 9, CPUM, CNPE-IBUNAM	C
Haemulopsis nitidus (Steindachner, 1869)	R	TEP	1, CPUM	
**Microlepidotus brevipinnis* (Steindachner, 1869)	R	TEP	CPUM	C
Orthopristis chalceus (Günther, 1864)	R	TEP	2, 4, CPUM	
Orthopristis reddingi Jordan & Richardson, 1895	R	TEP	1, 2, CPUM	
Pomadasys bayanus Jordan & Evermann, 1898	E	TEP	1, 2, CPUM	
Pomadasys branickii (Steindachner, 1879)	E	TEP	1, 7, 10, CPUM, ICMYL	
Pomadasys macracanthus (Günther, 1864)	E	TEP	2, CPUM	
Pomadasys panamensis (Steindachner, 1876)		TEP	1, 2, 9, CNPE-IBUNAM	C
Xenichthys xanti Gill, 1863	R	SP, TEP	2, CPUM, CNPE-IBUNAM	C
FAMILY SPARIDAE				
Calamus brachysomus (Lockington, 1880)	R	SP, TEP	1, 2, CPUM	C
FAMILY SCIAENIDAE				
Bairdiella armata Gill, 1863		TEP	1, 2	
Bairdiella ensifera (Jordan & Gilbert, 1882)		MP, PP	1, 2	
Bairdiella icistia (Jordan & Gilbert, 1882)		CP, MP	2	

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**Corvula macrops* (Steindachner, 1876)	R	TEP	CPUM	
Cynoscion nannus Castro-Aguirre & Arvizu-Martínez, 1976	PD	CP, MP	1, CPUM	C
Cynoscion phoxocephalus Jordan & Gilbert, 1882		MP, PP	1, 9, CPUM, CIBNOR	C
Cynoscion reticulatus (Günther, 1864)		TEP	1, 2	
**Cynoscion stolzmanni* (Steindachner, 1879)		TEP	ICMYL	
Elattarchus archidium (Jordan & Gilbert, 1882)	PD	TEP	2, CPUM	C
Isopisthus remifer Jordan & Gilbert, 1882		TEP	2	
Larimus acclivis Jordan & Bristol, 1898	PD	TEP	2, CPUM	C
Larimus argenteus (Gill, 1863)	PD	TEP	1, 2, CPUM, ICMYL	C
Larimus effulgens Gilbert, 1898	PD	TEP	1, 2, 9, CPUM	C
Menticirrhus elongatus (Günther, 1864)	E	SP, TEP	2, CPUM	C
Menticirrhus nasus (Günther, 1868)		TEP	2, CPUM, CNPE-IBUNAM	C
Menticirrhus panamensis (Steindachner, 1875)		TEP	1, 2	
Menticirrhus undulatus (Girard, 1854)	PD	SP, TEP	1, CPUM	C
Micropogonias altipinnis (Günther, 1864)		TEP	2	
**Micropogonias ectenes* (Jordan & Gilbert, 1882)	PD	SP, TEP	CPUM	C
Micropogonias megalops (Jordan & Gilbert, 1884)		CP, MP	1	
Odontoscion xanthops Gilbert, 1898	R	TEP	2, CPUM	
Ophioscion imiceps (Jordan & Gilbert, 1882)		MP, PP	2, ICMYL, CNPE-IBUNAM	
Ophioscion scierus (Jordan & Gilbert, 1884)		MP, PP	2, ICMYL	
**Ophioscion strabo* Gilbert, 1897		TEP	ICMYL	
**Ophioscion typicus* Gill, 1863		TEP	CNPE-IBUNAM	
**Ophioscion vermicularis* (Günther, 1867)	PD	MP, PP	CPUM	C
**Pareques fuscovittatus* (Kendall & Radcliffe, 1912)	R	MP	6, CPUM	
Umbrina bussingi López S., 1980	PD	MP, PP	1, 9, CPUM, ICMYL	C
Umbrina dorsalis Gill, 1862	R, E	TEP	2, 12, CPUM	
Umbrina xanti Gill, 1862	R, E	SP, TEP	1, 2, CPUM	C
FAMILY POLYNEMIDAE				
Polydactylus approximans (Lay & Bennett, 1839)	E	TEP	1, 2, 9, CPUM, SIO, CNPE-IBUNAM	C
Polydactylus opercularis (Gill, 1863)	E	SP, TEP	1, 2, 8, CPUM	C
FAMILY MULLIDAE				
Mulloidichthys dentatus (Gill, 1862)	R	TEP	2, 6, CPUM, ICMYL	C
Pseudupeneus grandisquamis (Gill, 1863)	R	TEP	1, 2, 9, CPUM, CNPE-IBUNAM	C
FAMILY KYPHOSIDAE				
Kyphosus analogus (Gill, 1862)	R	TEP	2, 4, CPUM	C
Kyphosus elegans (Peters, 1869)	R	TEP	2, 4, 5, CPUM	C
Kyphosus ocyurus (Jordan & Gilbert, 1882)	R	CT	1, 2, CPUM, SIO, ICMYL	C

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FAMILY CHAETODONTIDAE				
Chaetodon humeralis Günther, 1860	PM, R	TEP	1, 2, 4, 5, 6, 9, CPUM	
Johnrandallia nigrirostris (Gill, 1862)	PM, R	SP, TEP	2, 6, CPUM	I
FAMILY POMACANTHIDAE				
Holacanthus passer Valenciennes, 1846	R	TEP	2, 6, CPUM	
Pomacanthus zonipectus (Gill, 1862)	R	SP, TEP	1, 2, 6, 9, CPUM, ICMYL	
FAMILY CIRRHITIDAE				
Cirrhitichthys oxycephalus (Bleeker, 1855)	R	TEP	2, 6, CPUM	
Cirrhitus rivulatus Valenciennes, 1846	PM, R	TEP	2, 4, 5, 6, CPUM	
FAMILY MUGILIDAE				
Agonostomus monticola (Bancroft, 1882)	E	AA	1, 3, 10, 12, 13, CPUM, ICMYL	
**Chaenomugil proboscideus* (Günther, 1861)	PM	TEP	CPUM, ICMYL	
Mugil cephalus Linneaus, 1758		CT	1, 2	
Mugil curema Valenciennes, 1836	PM, E	AA	2, 3, 4, 5, 7, 8, 10, 12, 13, CPUM	C
FAMILY POMACENTRIDAE				
**Abudefduf declivifrons* (Gill, 1862)	PM, R	TEP	4, 5, CPUM	
Abudefduf troschelii (Gill, 1862)	PM, R	SP, TEP	2, 5, 6, CPUM	
Chromis atrilobata Gill, 1862	R	TEP	2, 6, CPUM	
Microspathodon bairdii (Gill, 1862)	PM, R	TEP	2, 5, CPUM	
Microspathodon dorsalis (Gill, 1862)	PM, R	SP, TEP	2, 4, 5, 6, CPUM	I
Stegastes acapulcoensis (Fowler, 1944)	PM, R	MP, PP	2, 5, 6, CPUM	
Stegastes flavilatus (Gill, 1862)	PM, R	MP, PP	2, 5, 6, CPUM, ICMYL	
Stegastes rectifraenum (Gill, 1862)	PM, R	SP, CP, MP	2, 5, CPUM, ICMYL	
FAMILY LABRIDAE				
Bodianus diplotaenia (Gill, 1862)	R	SP, TEP	2, 6, CPUM, ICMYL	
Halichoeres chierchiae di Caporiacco, 1947	R	TEP	2, 6, CPUM	
Halichoeres dispilus (Günther, 1864)	PM, R	TEP	2, 4, 5, 6, CPUM	
Halichoeres nicholsi (Jordan & Gilbert, 1882)	R	TEP	2, 6, CPUM	
Halichoeres notospilus (Günther, 1864)	PM, R	TEP	2, 6, CPUM	
**Iniistius pavo* (Valenciennes, 1840)	R	AP	CPUM	
**Novaculichthys taeniourus* (Lacepède, 1801)	R	AP	6	
**Thalassoma grammaticum* Gilbert, 1890	R	TEP	6, CPUM	
Thalassoma lucasanum (Gill, 1862)	PM, R	TEP	2, 5, 6, CPUM	
FAMILY SCARIDAE				
**Calotomus carolinus* (Valenciennes, 1840)	PD	CT	6, CPUM	
**Nicholsina denticulata* (Evermann & Radcliffe, 1917)	R	SP, TEP	CPUM	
**Scarus compressus* (Osburn & Nichols, 1916)	R	TEP	6, CPUM	
Scarus perrico Jordan & Gilbert, 1882	R	TEP	2, 6, CPUM	C
FAMILY URANOSCOPIDAE				
Astroscopus zephyreus Gilbert & Starks, 1897	PD	SP, TEP	2, CPUM	A

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FAMILY TRIPTERYGIIDAE				
Axoclinus storeyae (Brock, 1940)	PM, R	CP, MP	2, CPUM	
Enneanectes carminalis Jordan & Gilbert, 1882		TEP	2	
**Enneanectes glendae* Rosemblatt, Miller &Hastings, 2013	R	CP, MP	CPUM	
**Enneanectes macrops* Rosemblatt, Miller &Hastings, 2013	R	MP	CPUM	
FAMILY LABRISOMIDAE				
Brockius striatus (Hubbs, 1953)	PM, R	CP, MP	2, CPUM	
**Labrisomus multiporosus* Hubbs, 1953	PM, R	TEP	CPUM	
**Labrisomus xanti* Gill, 1860		SP, TEP	ICMYL	
Malacoctenus ebisui Springer, 1959	R	TEP	2, CPUM	
Malacoctenus hubbsi Springer, 1959	R	TEP	2, 5, CPUM	
**Malacoctenus mexicanus* Springer, 1959	R	TEP	CPUM	
**Malacoctenus tetranemus* (Cope, 1877)	PM, R	TEP	CPUM	
**Malacoctenus zonifer* (Jordan & Gilbert, 1882)	PM	TEP	CPUM	
**Paraclinus mexicanus* (Gilbert, 1904)	PM	TEP	CPUM	
**Starksia posthon* Rosenblatt & Taylor, 1971	R	MP, PP	CPUM	
**Starksia spinipenis* (Al-Uthman, 1960)	R	CP, MP	CPUM	
FAMILY CHAENOPSIDAE				
Acanthemblemaria balanorum Brock, 1940		TEP	2	
**Acanthemblemaria macrospilus* Brock, 1940	R	CP, MP	CPUM	
**Coralliozetus boehlkei* Stephens, 1963	R	TEP	CPUM	
**Ekemblemaria myersi* Stephens, 1963	R	TEP	CPUM	
**Protemblemaria bicirrus* (Hildebrand, 1946)	R	TEP	CPUM	
FAMILY DACTYLOSCOPIDAE				
Dactyloscopus amnis Miller & Briggs, 1962	E	MP, PP	1, 12, CPUM	
FAMILY BLENNIIDAE				
**Entomacrodus chiostictus* (Jordan & Gilbert, 1882)	PM	TEP	CPUM	
**Hypsoblennius brevipinnis* (Günther, 1861)	R	TEP	CPUM, SIO, ICMYL	
Ophioblennius steindachneri Jordan & Evermann, 1898	PM, R	TEP	2, 5, 6, CPUM, ICMYL	
Plagiotremus azaleus (Jordan & Bollman, 1890)	R	TEP	2, 6, CPUM	
FAMILY ELEOTRIDAE				
Dormitator latifrons (Richardson, 1844)	E	SP, TEP	1, 7, 8, 10, 12, 13, CPUM, CNPE-IBUNAM	
Eleotris picta Kner, 1863	E	TEP	1, 7, 8, 10, 12, 13, CPUM, CNPE-IBUNAM	
Gobiomorus maculatus (Günther, 1859)	E	TEP	1, 2, 7, 8, 10, 12, 13, CPUM, CNPE-IBUNAM	
**Gobiomorus polylepis* Ginsburg, 1953	E	Brackish	CPUM	
FAMILY GOBIIDAE				
Awaous banana (Valenciennes, 1837)	E	SP, TEP	3, 8, 12, CPUM	

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Barbulifer mexicanus Hoese & Larson, 1985		CP, MP	1	
**Bathygobius andrei* (Sauvage, 1880)	E	MP, PP	CPUM	
Bathygobius ramosus Ginsburg, 1947	PM	SP, TEP	1, 2, 5, CPUM, ICMYL	
**Bollmannia marginalis* Ginsburg, 1939		TEP	9	
**Bollmannia stigmatura* Gilbert, 1892		TEP	ICMYL	
**Coryphopterus urospilus* Ginsburg, 1938	R	TEP	CPUM	
Ctenogobius sagittula (Günther, 1861)	E	TEP	12, CPUM	
**Elacatinus punticulatus* (Ginsburg, 1938)	R	TEP	CPUM	
Gobionellus microdon (Gilbert, 1892)	E	TEP	1, 3, 7, 10, 12, 13, CPUM	
**Gymneleotris seminuda* (Günther, 1864)	R	TEP	CPUM	
Microgobius miraflorensis Gilbert & Starks, 1904		TEP	1	
**Sicydium multipunctatum* Regan, 1905	E	Freshwater	CPUM	
FAMILY MICRODESMIDAE				
Clarkichthys bilineatus (Clark, 1936)	PM	TEP	CPUM	
Microdesmus dorsipunctatus Dawson, 1968	E	TEP	12, CPUM	
FAMILY EPHIPPIDAE				
Chaetodipterus zonatus (Girard, 1858)	R	SP, TEP	1, 3, 8, 9, CPUM	C
Parapsettus panamensis Steindachner, 1876		TEP	1, 3	
FAMILY ZANCLIDAE				
**Zanclus cornutus* (Linnaeus, 1758)	R	SP, TEP	6, CPUM	
FAMILY ACANTHURIDAE				
Acanthurus triostegus (Linnaeus, 1758)	PM, R	AP	2, 5, 6, CPUM	
Acanthurus xanthopterus Valenciennes, 1835	R	AP	2, 6, CPUM	A
Prionurus punctatus Gill, 1862	PM, R	TEP	2, 5, 6, CPUM	A
FAMILY SPHYRAENIDAE				
Sphyraena ensis Jordan & Gilbert, 1882	R	TEP	1, 2, CPUM	C
FAMILY TRICHIURIDAE				
**Trichiurus nitens* Garman, 1899	PD	CT	CPUM	I
FAMILY SCOMBRIDAE				
Auxis brachydorax Collette & Aadland 1996		SP, TEP	2	
Euthynnus lineatus Kishinouye, 1920	PD	SP, TEP	1, 2, CPUM, SIO	C
Katsuwonus pelamis (Linnaeus, 1758)		CT	2	
**Sarda orientalis* (Temminck & Schlegel, 1844)	PD	AP	CPUM	C
Scomberomorus sierra Jordan & Starks, 1895	PD	SP, TEP	1, 2, CPUM	C
**Scomber japonicus* Houttuyn, 1782	PD	CT	CPUM	C
Thunnus alalunga (Bonnaterre, 1788)		CT	1	
FAMILY ISTIOPHORIDAE				
Istiophorus platypterus (Shaw, 1792)		AP	2	
FAMILY STROMATEIDAE				
Peprilus medius (Peters, 1869)	PD	TEP	2, CPUM	C
**Peprilus snyderi* Gilbert & Starks, 1904	PD	SP, TEP	CPUM	C
ORDER PLEURONECTIFORMES				
FAMILY PARALICHTHYIDAE				
Ancylopsetta dendritica Gilbert, 1890	PD	TEP	1, 2, 9, CPUM	C
Citharichthys gilberti Jenkins & Evermann, 1889	E	SP, TEP	1, 8, 12, CPUM	
**Citharichthys platophrys* Gilbert, 1891		TEP	SIO	

	Collected habitat (2010–2011)	Ichthyogeographic affinity	References and organisms voucher	The importance in fisheries
Cyclopsetta panamensis (Steindachner, 1876)		TEP	1	
Cyclopsetta querna (Jordan & Bollman, 1890)	PD	TEP	1, 2, 9, CPUM, SIO	C
Etropus crossotus Jordan & Gilbert, 1882	PD	SP, TEP	1, 2, 9, CPUM, SIO	C
**Etropus ectenes* Jordan, 1889	PD	SP, TEP	CPUM, SIO	
Etropus peruvianus Hildebrand, 1946		TEP	1	
Hippoglossina tetrophthalma (Gilbert, 1890)		TEP	2	
Paralichthys woolmani Jordan & Williams, 1897	D	TEP	1, 2, 9, CPUM, ICMYL	C
Syacium latifrons (Jordan & Gilbert, 1882)	PD	SP, TEP	1, 9, CPUM	C
**Syacium longidorsale* Murakami & Amaoka, 1992		PP	CIBNOR	
Syacium ovale (Günther, 1864)	PD	TEP	1, 2, 9, CPUM, ICMYL	C
FAMILY BOTHIDAE				
Bothus constellatus (Jordan, 1889)	PD	TEP	1, 2, 9, CPUM	A
**Bothus leopardinus* (Günther, 1862)		TEP	9	
Engyophrys sanctilaurentii Jordan & Bollman, 1890		TEP	1, SIO	
FAMILY ACHIRIDAE				
Achirus klunzingeri (Steindachner, 1879)	E	MP, PP	12, CPUM	
Achirus mazatlanus (Steindachner, 1869)	E	TEP	1, 7, 12, CPUM	
Achirus scutum (Günther, 1862)	E	TEP	1, CPUM	
Trinectes fonsecensis (Günther, 1862)	E	TEP	1, 9, 10, 12, 13, CPUM	I
FAMILY CYNOGLOSSIDAE				
Symphurus atricaudus (Jordan & Gilbert, 1880)		CP, MP	1	
**Symphurus callopterus* Munroe & Mahadeva, 1989		TEP	CAS	
Symphurus elongatus (Günther, 1868)	PD	SP, TEP	1, CPUM	I
**Symphurus leei* Jordan & Bollman, 1890		MP, PP	9, SIO, ICMYL	
ORDER TETRADONTIFORMES				
FAMILY BALISTIDAE				
Balistes polylepis Steindachner, 1876	R	SP, TEP	1, 2, 4, 6, 9, CPUM	
**Canthidermis maculata* (Bloch, 1786)	R	CT	CPUM	
Pseudobalistes naufragium (Jordan & Starks, 1895)	R	SP, TEP	2, 8, CPUM	
Sufflamen fraenatum (Latreille, 1804)	PD	AP	11, CPUM	
Sufflamen verres (Gilbert & Starks, 1904)	R	SP, TEP	2, 4, 6, CPUM	C
FAMILY MONACANTHIDAE				
**Aluterus monoceros* (Linnaeus, 1758)	R	CT	9, CPUM	C
Aluterus scriptus (Osbeck, 1765)	R	CT	1, 6, CPUM-photo	
FAMILY OSTRACIIDAE				
Ostracion meleagris Shaw, 1796	R	AP	2, 6, CPUM	
FAMILY TETRAODONTIDAE				
**Arothron hispidus* (Linnaeus, 1758)	R	CT	CPUM, ICMYL	
Arothron meleagris (Lacèpede, 1798)	R	CT	2, 6, CPUM	I

	Collected habitat (2010–2011)	Ichthyogeographic affinity	References and organisms voucher	The importance in fisheries
****Canthigaster janthinoptera* (Bleeker, 1855)	R	AP	CPUM	
Canthigaster punctatissima (Günther, 1870)	R	TEP	2, 6, CPUM	
**Lagocephalus lagocephalus* (Linnaeus, 1758)		CT	9	
**Sphoeroides sechurae* Hildebrand, 1946	R	TEP	9, CPUM	A
Sphoeroides annulatus (Jenyns, 1842)	R, E	SP, TEP	1, 2, 4, 6, 8, 12, CPUM, SIO	
Sphoeroides lobatus (Steindachner, 1870)	R	TEP	2, 6, CPUM	I
FAMILY DIODONTIDAE				
Diodon holocanthus Linnaeus, 1758	R	CT	2, 6, 8, 9, CPUM	
Diodon hystrix Linnaeus, 1758	R	CT	1, 2, 4, 6, 9, CPUM	I

* New record for the state of Michoacan. **New record for the Mexico. Collection habitat: Reef (R), rocky intertidal or tidal pool (PM), estuary (E), demersal (D) pelagic-demersal (PD). Zoogeographical affinity: Circumtropical (CT), Amphiamerican (AA), Transpacific (AP) San Diegan province (SP), Cortés province (CP), Mexican province (MP), Panamic province (PP). Record from literature: Castro-Aguirre et al. 2006 (1), Madrid-Vera et al. 1998 (2), Medina-Nava et al. 2005 (3), Galván-Torres, 1989 (4), Aguirre-Villaseñor, 1991 (5), Domínguez-Domínguez, 1998 (6), González-Luna, 2000 (7), Madrigal-Guridi, 2006 (8), Sánchez-Aguilar, 2007 (9), Sandoval-Huerta et al. 2012 (10), Palacios-Morales et al. 2014 (11), Sandoval-Huerta et al. 2014 (12), Sandoval-Huerta et al. 2015 (13). Records from Fish Collection of Universidad Michoacana de San Nicolás de Hidalgo (CPUM), Fish Collection of the Institute of Biology of the National Autonomous University of Mexico (CNPE-IBUNA), fish collection of Instituto de Ciencias del Mar y Limnología (ICMYL), fish collection of California Academy of Sciences, San Francisco California, E.U.A. (CAS), the Marine Vertebrate Collection of Scrippps Institution of Oceanography, San Diego, California (SIO) and fish collection of Biological Research Center Northwest S.C. (CIBNOR). Fishery importance: personal consumption (A), commercial use (C) and discarded (I).

Pristis pristis (Linnaeus, 1758), *Aetobatus laticeps* (Euphrasen, 1790), *Apogon pacificus* (Herre, 1935), *Coryphaena hippurus* Linnaeus, 1758, *Kyphosus ocyurus* (Jordan & Gilbert, 1882), and *Novaculichthys taeniourus* (Lacepède, 1801). Of the 436 species, 131 were new records for the Michoacán State, and *Canthigaster janthinoptera* (Bleeker, 1855) was a new record for Mexico (Table 1).

For the specimens collected during field trips, some were collected from a single habitat type: 123 (40%) were collected in reefs, 57 (19%) in the pelagic-demersal zone, 46 (15%) in estuarine zones, 17 (6%) in the demersal zones, and 14 (5%) in rocky intertidal zones. Forty-seven species were collected in more than one habitat type (Table 1 and Fig. 2).

The artisanal fishery captures yielded 154 species. The families with the highest number of species were Carangidae (17), Haemulidae (15), Sciaenidae (13), Serranidae (10), and Lutjanidae (7). Of these, 104 (68%) were commercially valuable, 23 (15%) were used for direct consumption or as bait. Twenty-seven (18%) were bycatch, that are normally rejected and thrown back (Fig. 3).

Forty-six (11%) of the species were circumtropical, 27 (6%) transpacific, and seven (2%) amphi-American; whereas 350 (81%) belonged to the TEP. Of these 77

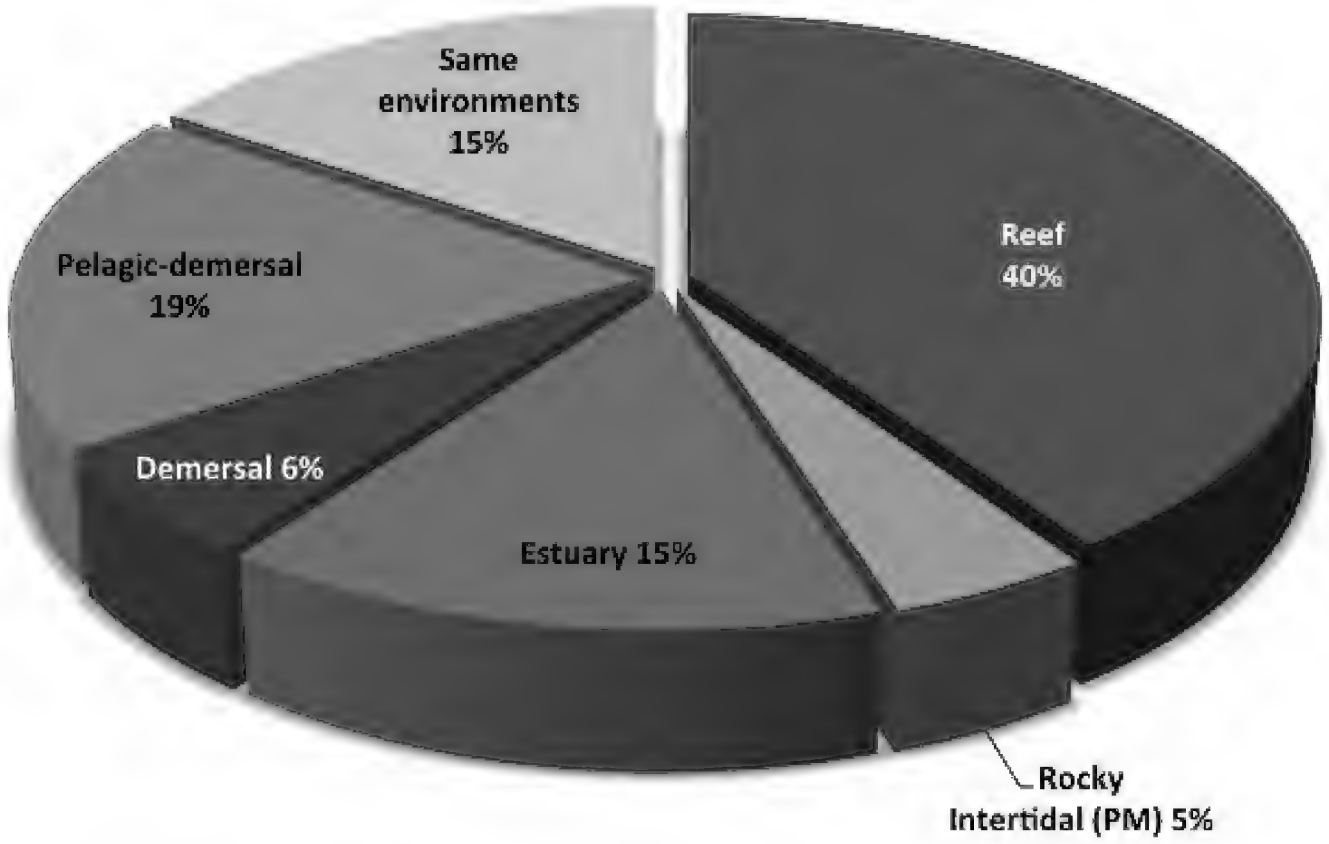

Figure 2. Percent of species collected in each habitat.

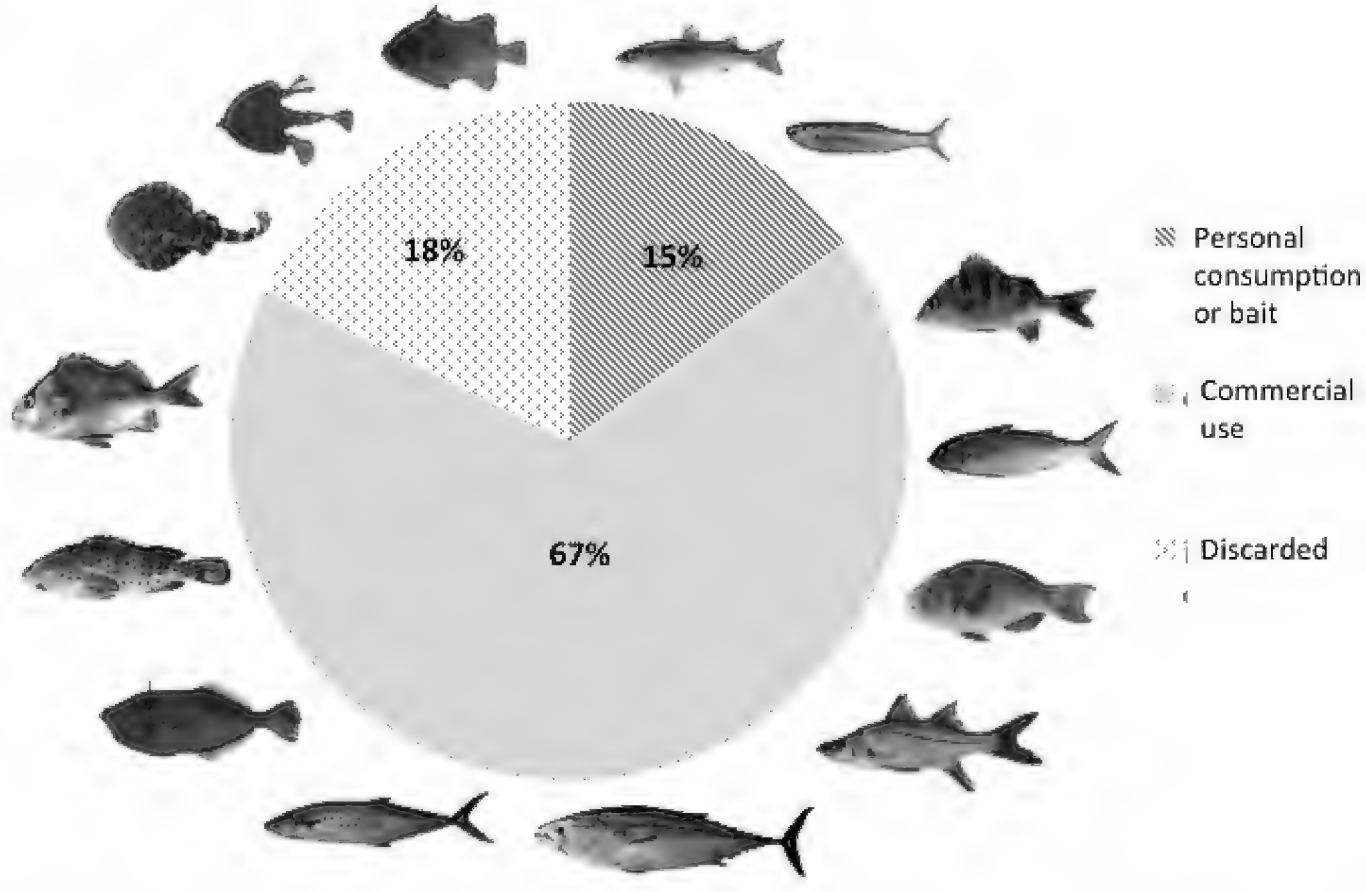

Figure 3. Classification of commercial importance of the species captured in the Michoacán coastal fisheries.

(18%) were widely distributed from the San Diegan province to the Panamic province, and 3 (1%) from the San Diegan province to the Mexican province. The largest number of species, 216 (49.2%), were found in the three provinces of the TEP; 15

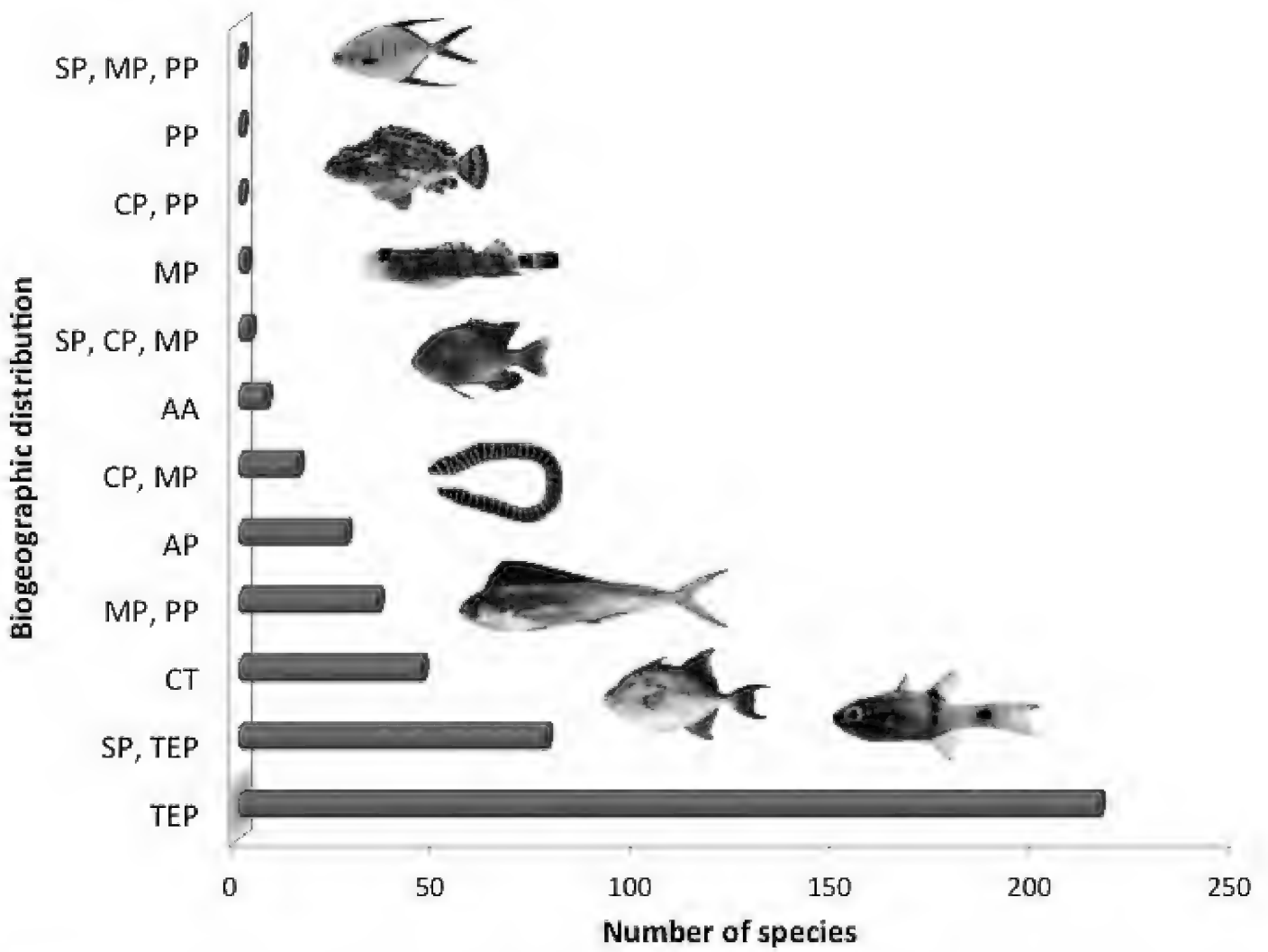

Figure 4. Biogeographic affinity of the fish fauna recorded on the Michoacán Coast. TEP, Tropical Eastern Pacific; CT, Circumtropical; AP, Transpacific species; AA, Amphi-American species; SP, San Diegan province; CP, Cortez province; MP, Mexican province; PP, Panamic province.

(3%) were restricted to the Cortez and the Mexican provinces; 35 (8%) were limited to the Mexican and Panamic provinces; and 2 (0.5%) were endemic to the Mexican province (Fig. 4). Six species collected in the estuarine ecosystems occurred in fresh or brackish water habitats and were not included in the marine biogeographical affinity categories: *Gobiomorus polylepis* Ginsburg, 1953 (brackish), *Sicydium multipunctatum* Regan, 1905, *Gobiesox mexicanus* Briggs & Miller, 1960, and *Poecilia butleri* Jordan, 1889 (fresh water). The introduced species *Pterygoplichthys disjuntivus* (Weber, 1991) and *Cyprinus carpio* Linnaeus, 1758 were also omitted.

Discussion

The present checklist represents the most updated and comprehensive systematic list of fishes recorded from the coast of the Mexican State of Michoacán. Of the species cataloged, 30% were first records for this State. The highest proportion of cataloged species was collected in reefs (40%). The pelagic zone accounted for 24% of the species collected, indicated a requirement for future studies of the demersal and pelagic

zones with increased sampling effort (Fig. 2). The highest number of new records for Michoacán was found in reefs, chiefly species exhibiting cryptic behavior (Table 1). This could be related to the sampling methods employed, which had not been previously used; the few previously reported species with cryptic behavior were primarily bycatch (Madrid-Vera 1998, Castro-Aguirre et al. 2006, Moncayo-Estrada et al. 2006, Chávez-Comparan 2008, Márquez-Espinoza 2012). Another source of new species records from Michoacán was the intertidal zone (Table 1), for which no published records are available. In general, the number of species in the area may be increased if sampling effort is expanded and records from shrimp and tuna bycatches are included. A new record was obtained for Mexico, two specimens of *C. janthinoptera* (Bleeker, 1855) were collected from Barco Hundido del Faro de Bucerias (CPUM 4532, N 18°21'8.82'W -103°31'18.71'), which identification was corroborated by BLAST (http://www.ncbi.nlm.nih.gov/genbank) and by boldsystems (http://www.boldsystems.org), searches showing 99% similarity in the cytochrome oxidase subunit 1 gene (COX-1) to specimens identified as *C. janthinoptera* from the south Tropical Eastern Pacific and the Indo-Pacific Ocean (GenBank accession numbers: KX505745 and KX505746). One specimen of *Bathygobius andrei* (Sauvage, 1880) (Gobiidae) was also reported in the Chuta estuary (CPUM 3296, 18°2'1"N and 102°33'33"W), representing an extension of its previously known northern distribution limit of the coast of Chiapas (Gómez-González et al. 2012). One specimen of *Calotomus carolinus* (Valenciennes, 1840) was collected from rocky reef in Faro de Bucerias location (18°20'50"N and 103°30'37"W), extending its extension range in the TEP.

In artisanal fishing (Fig. 3), the species considered to have the highest economic value belong chiefly to Carangidae (e.g. *Alectis ciliaris*, (Bloch, 1787)), Lutjanidae (e.g. *Lutjanus guttatus*, (Steindachner, 1869)), Paralichthyidae (e.g. *Cyclopsetta querna*, (Jordan & Bollman, 1890)), Centropomidae (e.g. *Centropomus armatus*, Gill, 1863), and Serranidae (e.g. *Epinephelus labriformis*, (Jenyns, 1840)) (Table 1). Most of the elasmobranch capture, with the exception of the fins, is considered of low economic value. A high number of neonatal and juvenile hammerhead sharks (*Sphyrna* sp.), were captured, as well as pregnant *Rhinobatos glaucostigma* Jordan & Gilbert, 1883, *Gymnura marmorata* (Cooper, 1863), and *Urotrygon* spp. In general, the elasmobranchs, due to their unique biological and ecological characteristics, present low population growth and are considered highly vulnerable (Frisk et al. 2005, Hutchings et al. 2012). We accordingly recommend review and enforcement of the relevant legislation.

Bycatch in commercial fishing is frequently used for personal consumption, bait (~50%), or discarded (Fig. 3). Species with no current market value may have high nutrient value; hence the number of species with potential to be commercialized is underestimated. In offshore fisheries, these species often have commercial value. For instance, *Scorpaena mystes* (Jordan & Starks, 1895) reaches 35.6 cm and is marketed in regions such as Baja California. *Trichiurus nitens* Garman, 1899 supports a small fishery in the central portion of the littoral zone of Ecuador (pers. obs. Romero-Gallardo), whereas, in Michoacán, this species is not used for human consumption.

It was observed that 49% of the listed species are reported as also occurring throughout the three TEP provinces, with 8% of the species reported only in the Panamic and Mexican provinces, being mostly of tropical affinity, agreeing with previous fish fauna surveys in the area (Castro-Aguirre et al. 2006, Moncayo-Estrada 2006). The presence of 81 species (19%) with affinity to the San Diegan province (Fig. 4), a temperate-warm zone, reflects the dynamics of the current flow system of the Michoacán coast, reaffirming this region as a transition zone.

Although visual censuses and photo identification of fish species is widely used for the study of richness, diversity, and ecology of marine habitats (Aguilar-Palomino 2002, Palacios-Salgado 2005, Galván-Villa 2016), it is necessary to rely on reference organisms for taxonomic corroboration. A high proportion of small, nocturnal, or ecologically cryptic species may not be counted in a visual census, especially when the fish fauna of the area under study is not well known, as is the case for the Michoacán State.

The collections obtained in the present study enriched the records of the CPUM collection by 19%, since the majority of marine species previously collected remain in collections outside of Michoacán. Many species reported in this study as new records (Table 1) were included by Robertson and Allen (2015), although these authors listed them in the littoral zone of Michoacán coastline only as potential distribution based on habitat suitability. We have confirmed the distribution of such fish, as exemplified by the first formal record of 24 ecologically cryptic species. Our work expanded on the most complete fish fauna checklist previously available for the area by 32.5% (Madrid et al. 1998) and will undoubtedly represent important input for decisions about conservation and management of the coastal area of Michoacán State.

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